DC MOTOR INTERFACING:

- DC motor is a device that translates electrical pulses into mechanical movement.
- The DC motor has + and – leads
- Connecting them to a DC voltage source moves the motor in one direction and by reversing the polarity, the DC motor will move in opposite direction.

Unidirectional Control:

- The following figure 5.13 shows the DC motor rotation for clockwise (CW) and counterclockwise (CCW) rotations.

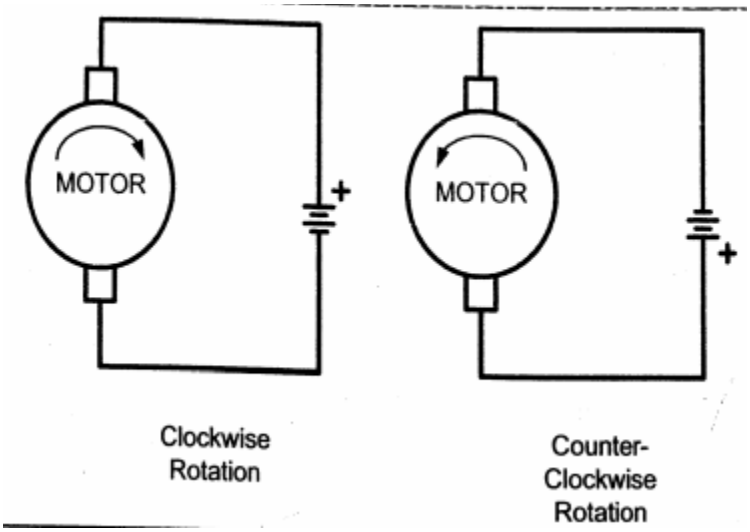

Figure 5.13 DC Motor Rotation (Permanent Magnet Field)

Bidirectional Control:

- With the help of relays or some specially designed chips we can change the direction of the DC motor rotation.
- Figure 5.14 through 5.17 shows the basic concepts of H-Bridge control of DC motors.

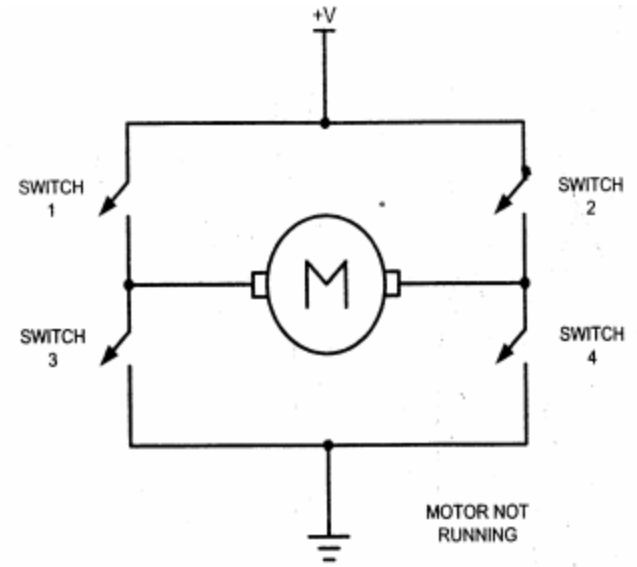

Figure 5.14 H-Bridge Motor Configuration

- Figure 5.2 shows the connection of an H-Bridge using simple switches.
- All the switches are open, which does not allow the motor to turn.

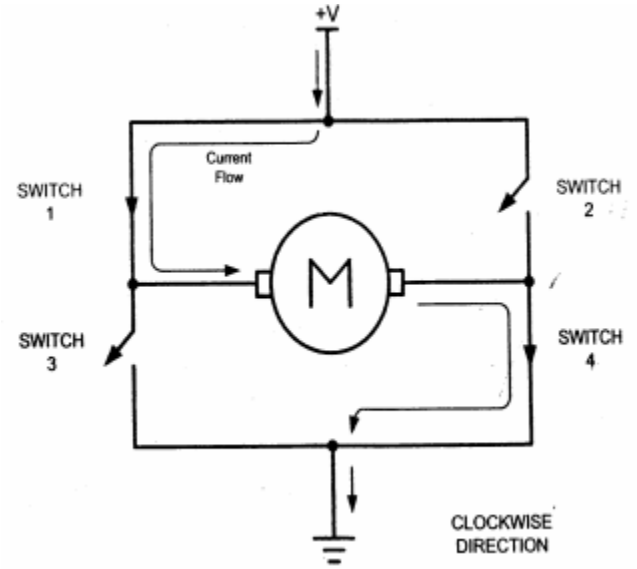

Figure 5.15 H-Bridge Motor Clockwise Configuration

- Figure 5.3 shows the switch configuration for turning the motor in one direction.
- When switches 1 and 4 are closed, current is allowed to pass through the motor.

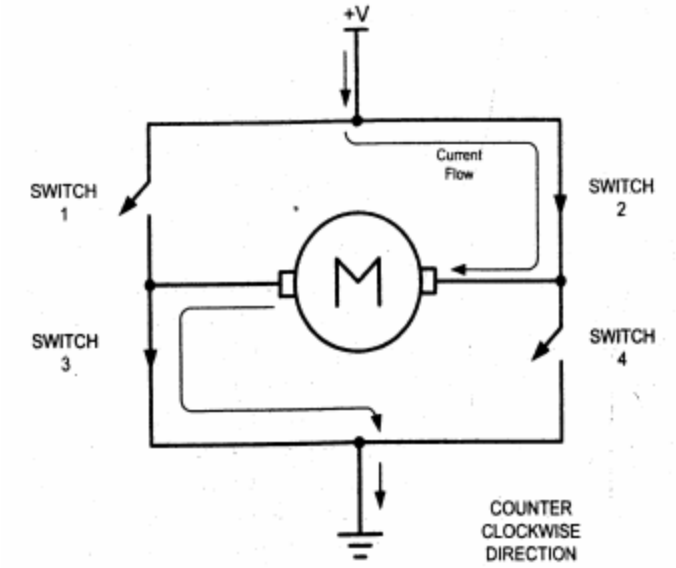

Figure 5.16 H-Bridge Motor Counterclockwise Configuration

- Figure 5.3 shows the switch configuration for turning the motor in the opposite direction from the configuration of Figure 5.3
- When switches 2 and 3 are closed, current is allowed to pass through the motor.

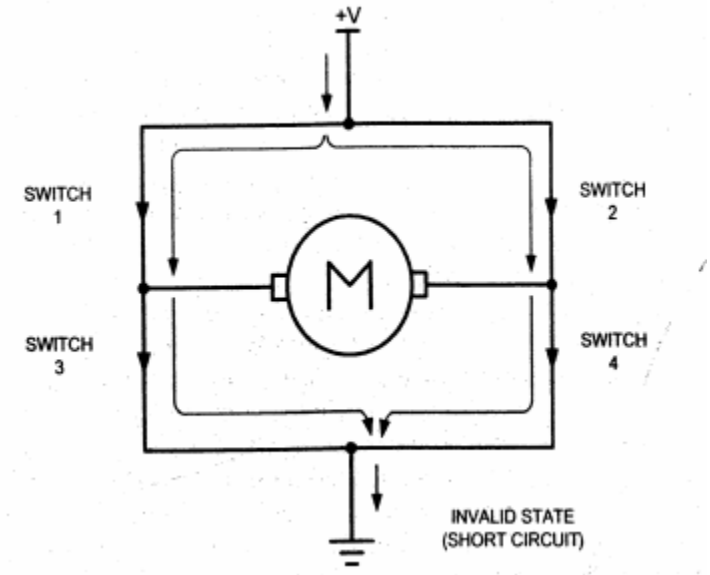

Figure 5.17 H-Bridge in an invalid configuration.

- Figure 5.4 shows an invalid configuration.
- Current flows directly to ground, creating a short circuit.
- The same effect occurs when switches 1 and 3 are closed or switches 2 and 4 are closed.
- Table 5.10 shows some of the logic configurations for the H-Bridge design.

Table 5.10 H-Bridge Logic Configurations

Motor Operation	SW1	SW2	SW3	SW4
OFF	Open	Open	Open	Open
Clockwise	Closed	Open	Open	Closed
Counter Clockwise	Open	Closed	Closed	Open
Invalid	Closed	Closed	Closed	Closed

- H-Bridge control can be created using relays, transistors, or a single IC Solution such as the L293.
- When using relays and transistors, must ensure that invalid configuration do not occur.
- **Example:**

  A switch is connected to pin P2.7. Write a program to monitor the status of SW and perform the following:

  (a) If SW=0, the DC motor moves clockwise

  (b) If SW=1, the DC motor moves counterclockwise

  Solution:

```
            ORG 0H
MAIN:       CLR P1.0            ; Switch 1
            CLR P1.1            ; Switch 2
            CLR P1.2            ; Switch 3
            CLR P1.3            ; Switch 4
            SETB P2.7
MONITOR:    JNB P2.7, CLOCKWISE
            SETB P1.0           ; Switch 1
            CLR P1.1            ; Switch 2
            CLR P1.2            ; Switch 3
            SETB P1.3           ; Switch 4
            SJMP MONITOR
CLOCKWISE:  CLR P1.0            ; Switch 1
            SETB P1.1           ; Switch 2
            SETB P1.2           ; Switch 3
            CLR P1.3            ; Switch 4
            SJMP MONITOR
            END
```

Motor Control Using L293

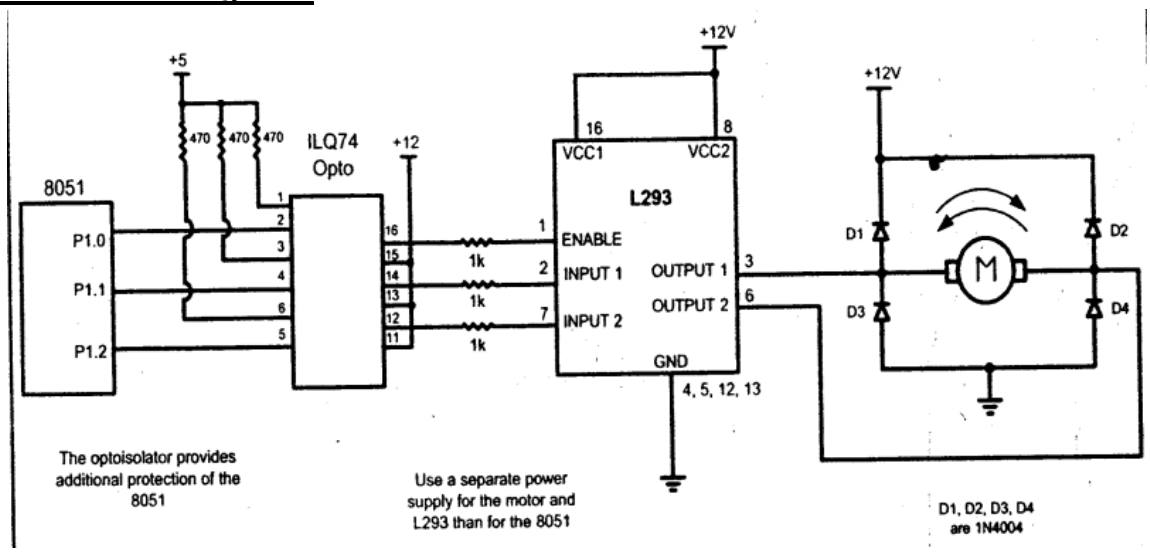

Figure 5.18 Bidirectional Motor Control Using L293 Chip

- Figure 5.18 shows the connection of L293 to an 8051.
- **Example:**

  A switch is connected to pin P2.7. Write a program to monitor the status of SW and perform the following:

  (a) If SW=0, the DC motor moves clockwise

  (b) If SW=1, the DC motor moves counterclockwise

  Solution:

```
ORG 0H
MAIN:       CLR P1.0
            CLR P1.1
            CLR P1.2
            SETB P2.7
MONITOR:    SETB P1.0              ; Enable the Chip
            JNB P2.7, CLOCKWISE
            CLR P1.1               ; Turn Motor counterclockwise
            SETB P1.2
            SJMP MONITOR
CLOCKWISE:  SETB P1.1
            CLR P1.2               ; Turn Motor clockwise
            SJMP MONITOR
            END
```

PWM:

- The speed of the motor depends on three factors
  - Load
  - Voltage
  - Current
- For a given fixed load we can maintain a steady speed by using a method called Pulse Width Modulation(PWM)

- By changing (modulating) the width of the pulse applied to the DC motor we can increase or decrease the amount of power provided to the motor, thereby increasing or decreasing the motor speed.
- Notice that although the voltage has a fixed amplitude, it has a variable duty cycle
- That means the wider the pulse, the higher the speed.
- PWM is do widely used in DC motor control that some microcontrollers come with the PWM circuitry embedded in the chip.

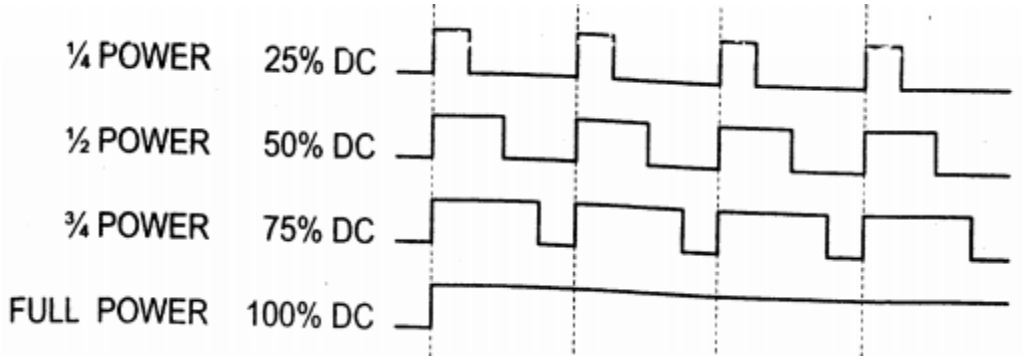

Figure 5.19 Pulse Width Modulation Comparison

Optoisolator:

- An **optoisolator** (also known as optical coupler, optocoupler and **opto-isolator**) is a semiconductor device that uses a short optical transmission path to transfer an electrical signal between circuits or elements of a circuit, while keeping them electrically isolated from each other.
- Advantage: Their high electrical isolation between the input and output terminals allowing relatively small digital signals to **control** much large AC voltages, currents and power.

Reference:

- Muhammed Ali Mazidi, Janice Gillispie Mazidi and Rolin D.McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”